WATER FREEZE CONTROL FOR HOT TUB SPA

This invention relates to spas, and, in particular to spas used in climates where water tends to freeze when the temperature gets cold. This application claims priority of provisional application Serial No. 60/106,229 filed 10/30/98.

BACKGROUND OF THE INVENTION

A spa (also commonly known as a "hot tub") is a therapeutic bath in which all or part of the body is exposed to forceful whirling currents of hot water. Spas are popular throughout the world but are especially popular in areas of cold climate, such as at ski resorts and other extremely cold locations. Spa users tend to find it especially pleasurable to move from an area of extreme cold to the comfort of a nice, hot spa. However, there is an unfortunate problem associated with operating and maintaining a spa in a cold location. If a spa is operated in a climate where water tends to freeze, unless appropriate measures are taken, water inside the plumbing of the spa may also freeze and cause damage to the plumbing. Conventionally, the water in the tub itself is maintained in its liquid state by the temperature control system of the spa which keeps the water in the tub at a temperature that is high enough to prevent freezing of the water in the tub. The problem with which the industry is faced, however, is that the water in the plumbing system of the spas will cool down much faster than the water in the tub itself. Therefore, the water in the plumbing may freeze while the water in the tub is still in its liquid state.

U.S. Pat. Nos. 5,361,215, 5,550,753, and 5,559,720 disclose a solution to the problem of water freezing in spa plumbing. These patents teach that the problem can be solved through the installation of temperature sensors that sense the temperature of the water in the plumbing and the tub and will circulate the water through the plumbing if the water in the plumbing gets too cold.

A prior art spa 1 is shown in FIG. 1. The prior art spa has temperature sensor 3 which measures the water temperature inside tub 7 and temperature sensor 5 which measures the water temperature inside water heater 9. In the prior art, sensor 5 is used not only to protect the user from excessive temperature, but also for freeze protection. To protect the

user for excessive temperature, sensor 5 will send an electrical signal to spa controller 11 if it senses a temperature greater than approximately 119 deg. F. If this temperature is detected by sensor 5, spa controller 11 will then shut – off water heater 9.

As a freeze protection system, the prior art works as follows. While spa users are using the spa, they can manually set the temperature of the spa by entering the desired temperature into spa controller 11 via keypad 15. When the spa is no longer in use, and the users have left the spa, spa controller 11 continues to automatically control the temperature of the spa. In the prior art, when the temperature in spa tub 7 falls below a preset temperature (as detected by sensor 3), sensor 3 sends a signal to spa controller 11. Spa controller 11 turns on heater 9 and water pump 13. Hot water is then pumped into spa tub 7. Heater 9 and water pump 13 will remain on until sensor 3 reports a temperature above the preset temperature. Likewise, in the prior art, when sensor 5 senses a plumbing temperature less than a preset temperature (for example, 40 deg. F.), it will cause spa controller 11 to turn on heater 9 and water pump 13. Hot water is then pumped back into spa tub 7. Heater 9 and water pump 13 will remain on until sensor 5 reports a temperature greater than the preset temperature (i.e., 40 deg. F.).

Unfortunately, the solution offered by the prior art has serious problems. If there is more than one plumbing circuit in a spa, more than one temperature sensor will be needed. In other words, each plumbing circuit will require its own temperature sensor that provides information to spa controller 11. Because of the extra expense involved, Applicants know of no system that currently offers separate sensors for each plumbing circuit. Also, there is no accommodation in the prior art for protection of the air blower and its associated piping. Although, the air blower functions to blow air into the spa, it is a common occurrence for water to leak back through air injector valves 4 into air blower piping 6 (FIG. 1). Consequently, water inside air blower piping 6 can also expand upon freezing causing severe, costly damage. Another disadvantage is that the plumbing temperature sensor disclosed in the prior art is located at the water heater which causes the sensor to return a value for plumbing water temperature that is actually warmer than

the true water temperature in most of the plumbing. This means that water in certain parts of the plumbing may freeze while the water near sensor 5 is still in a liquid state.

What is needed is a better freeze control system for spas.

SUMMARY OF THE INVENTION

The present invention provides a freeze control system for a spa for maintaining the temperature of the water inside the spa and the spa's associated piping above the freezing level. Elements include: 1) a heating element for heating the water, 2) at least one pump for pumping the heated water, 3) a first sensor for detecting the temperature of the water in the spa tub, 4) a second sensor for detecting the temperature of the ambient air around the spa, and 5) a computer programmed to process signals generated by the first sensor and the second sensor, wherein the computer selectively activates and deactivates the heating element and the at least one pump.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a prior art spa.

FIG. 2 shows a first preferred embodiment of the present invention.

FIG. 3 shows a second preferred embodiment of the present invention.

FIG. 4 shows a perspective view of the second preferred embodiment of the present invention.

FIG. 5 shows a detailed view of the spa controller.

FIG. 6 shows a perspective view of the first preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A detailed description of a preferred embodiment of the present invention is seen by reference to FIGS. 2 – 6.

First Preferred Embodiment

As seen in FIG. 2, spa 2 contains sensor 17. In a first preferred embodiment sensor 17 is mounted to mounting board 22 underneath spa skirt 20 near spa 2's piping, as shown in FIG. 6. This location is chosen so that sensor 17 is exposed to the air that is near the piping system of spa 2. In a preferred embodiment, spa controller 12 contains a CPU that is programmed to maintain the temperature of the water in spa tub 7 and the water in spa 2's piping in an optimum operating range (i.e., below a level that is too hot for a user, but above the level which would cause freezing of the water in spa 2's piping). As in the prior art, sensor 3 senses the temperature of the water in spa tub 7. Sensor 5 senses the temperature of water near water heater 9.

In the present invention, sensor 3 is still part of the freeze control system in that when the temperature in spa tub 7 drops below a first predetermined value, sensor 3 sends a signal to spa controller 11. This first predetermined value can be high (i.e., 104 deg. F.) for spas that get fairly regular use, or low (i.e., 59 deg. F) for example, for a homeowner who did not plan on using his spa for an extended period of time. In the first preferred embodiment, Spa controller 11 is model number SSPA, manufactured by Gecko Electronique with offices in Quebec City, Quebec, Canada. Spa controller 11 turns on heater 9 and water pump 13 when the temperature in spa tub 7 drops below the first predetermined value. Hot water is then pumped back into spa tub 7. Heater 9 and water pump 13 will remain on until sensor 3 reports a second predetermined temperature slightly above the first predetermined temperature. However, in the preferred embodiment of the present invention, sensor 5 is no longer part of the freeze control system. Instead, sensor 5 is used only to shut off heater 9 when the temperature at heater 9 gets too hot (approximately 119 deg. F.).

In the present invention, sensor 17 has been added to the system and senses the temperature of ambient air around spa 2's piping. In the preferred embodiment of the present invention, sensor 17 is a HT Thermistor sensor (part no. Gecko: 530SB0016) manufactured by Ishicuka Electronic with offices in Japan.

In this first preferred embodiment, sensor 17 detects the true value of ambient air near the piping of spa 2. The programming of spa controller 12 has been modified from spa controller 11 (FIG. 1) to include the ability to be able to utilize information reported by sensor 17 to better regulate the water temperature of spa 2 to prevent freezing of its associated piping.

Applicants call this programming "Smart Winter Mode" and its functionality is illustrated by reference to Table 1 below.

TABLE 1

Ambient Air Temp	Conduct a 1 minute purge every:
40 deg. F.	2 hours
28 deg. F.	1 hour
14 deg. F.	30 minutes
5 deg. F.	15 minutes

In the first preferred embodiment, as the temperature at sensor 17 decreases to 40 deg. F sensor 17 will send an electrical signal to spa controller 12. Spa controller 12 will then start water pumps 13 and 14 and air blower 16. They will each run for 1 minute every two hours. As shown in Table 1, if the temperature drops to 28 deg. F at sensor 17, water pumps 13 and 14 and air blower 16 will conduct a 1-minute purge every hour. Likewise, when sensor 17 reports a temperature of 14 deg. F, the system will purge every 30 minutes and at 5 deg. F. the system will purge every 15 minutes. In the first preferred embodiment, as an extra added measure of protection, after the ambient has risen above 40 deg. F., spa controller 12 will continue to run water pumps 13 and 14 and air blower 16 for one minute every 2 hours for the next 24 hours.

Second Preferred Embodiment

A second preferred embodiment is seen by reference to FIGS. 3, 4 and 5. In the second preferred embodiment, sensor 17 is attached directly to printed circuit board (PCB) 12A inside spa controller 12, as shown in FIGS 4 and 5. In the second preferred embodiment, Spa controller 12 is model number SSPA, manufactured by Gecko Electronique with offices in Quebec City, Quebec, Canada. By attaching sensor 17 directly to PCB 12A, a substantial cost savings is realized in that the expense of mounting sensor 17 at another

location near spa 2's piping (as was shown in the first preferred embodiment) is avoided. In other words, when sensor 17 is mounted on PCB 12A, funds that would be spent on cabling, housing and connectors are saved. However, it should be noted that when sensor 17 is mounted to PCB 12A, sensor 17 is exposed not only to ambient air temperature, but also to the temperature of the area around PCB 12A which is heated by the other components also attached to PCB 12A. Hence, a correction factor needs to be programmed into spa controller 12 account for the heat generated by spa controller 12's components. Through experimentation for spa controller 12 model number SSPA, Applicants have determined the following correlation shown in Table 2:

TABLE 2

Temp at Sensor 17	Ambient Air Temp.	Conduct a 1 minute purge every:
68 deg. F	40 deg. F.	2 hours
59 deg. F	28 deg. F.	1 hour
54 deg. F	14 deg. F.	30 minutes
50 deg. F	5 deg. F.	15 minutes

In the second preferred embodiment, as the temperature at sensor 17 decreases to 68 deg. F (ambient air temp. = 40 deg. F), sensor 17 will send an electrical signal to spa controller 12. Spa controller 12 will then start water pumps 13 and 14 and air blower 16. They will each run for 1 minute every two hours. As shown in Table 1, if the temperature drops to 59 deg. F at sensor 17, water pumps 13 and 14 and air blower 16 will conduct a 1-minute purge every hour. Likewise, when sensor 17 reports a temperature of 54 deg. F, the system will purge every 30 minutes and at 50 deg. F. the system will purge every 15 minutes. As an extra added measure of protection, after the ambient has risen above 40 deg. F. (i.e., sensor 17 reports a Temp = 68 deg. F), spa controller 12 will continue to run water pumps 13 and 14 and air blower 16 for one minute every 2 hours for the next 24 hours.

The above-described invention is an improvement over the prior art in that it provides a much more reliable and effective manner of preventing freezing while at the same time minimizing costs.

While the above description contains many specifications, the reader should not construe these as limitations on the scope of the invention, but merely as exemplifications of preferred embodiments thereof. Those skilled in the art will envision many other possible variations are within its scope. For example, although the above embodiments described a spa that has an air blower, there are many spas that do not have air blowers. The above invention would work equally well for spas without air blowers. For example, spa controller 12 would be programmed to start the water pumps when sensor 17 detected a low temperature. Also, although the above embodiments discuss using model number SSPA for spa controller 12, those of ordinary skill in the art will recognize that it would be possible to substitute a different spa controller for spa controller 12. For the second preferred embodiment, if a different spa controller 12 is used, a new correction factor would have to be calculated to determine a correlation table appropriate for the different spa controller. Accordingly the reader is requested to determine the scope of the invention by the appended claims and their legal equivalents, and not by the examples which have been given.